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THE NAVY AND ITS PROSPECTS OF REHABILITATION.

By REAR-ADMIRAL EDWARD SIMPSON, U. S. N., President of the Institute.

Ever since I received the notification that I had been elected the President of this Institute for the ensuing year, I have had a desire to acknowledge the compliment, and to express my appreciation of the honor that you have done me in associating me with the distinguished officers who preceded me in this office. It occurred to me that the most fitting and appropriate method of doing this, and at the same time of showing my interest in the Institute, would be to prepare a paper to be read at one of the meetings, or to be published in our Proceedings. The range of subjects to choose from is very wide, for, as this Institute has to do with matters pertaining to the Navy, it is hard to indicate any subject known to modern progress that would not be appropriate; but I concluded to confine myself to no one of these, but rather to assume the position of an observer of

what is now transpiring, to suggest what seems to me to be needful, and to consider the prospects that are held out in the way of rehabilitation of the Navy.

I am aware that in making an address I am departing from custom, but I am willing to endure the penalty that is imposed for the sake of putting before you some ideas which I could not find a more convenient method of presenting. I have been employed lately on duties relating to ships and gun foundries, which afforded me opportunities for observation, and naturally encouraged thought; and it occurred to me that remarks on these subjects, and ideas resulting from the study of them, could not be altogether without profit, and might be found interesting. I, accordingly, devote much of my space to these two subjects, avoiding in the latter, gun foundries, a repetition of what you have read in the report of the Gun Foundry Board, but supplementing what is therein stated by some explanations, which can be familiar only to those who were members of the Board.

I was the more inclined to address you in this manner from the fact that your notice of me and my work comes at the time when, for reasons beyond my control, I am about to be retired from active service, and will be for the rest of my life only "a looker-on in Vienna," and it is for me a suitable time to sum up accounts and, as it were, to take an account of stock.

My first associations with the Navy were nearly 46 years ago. It then occupied a very creditable position, but I saw it advance to its zenith when its ships were the models for the imitation of the world, and its guns were the standard of excellence. I have seen it in its decline until its *materiel* has reached the point where it can be cited as the standard of inefficiency. Even our own daily press make it a target for its shafts of ridicule. Thanks to the Naval Academy and the abiding high tone of the service, its personnel is above reproach, and, in this day of the decadence of our sh ps and guns, it finds itself equipped for the trying work now before it.

This condition of preparation is the result of the training of officers at the Academy, where the door of knowledge was opened to them, and to their own individual efforts to advance in the studies inaugurated at that institution. This Institute is one of the proofs of the aspiration for advancement that felt the need of a field in which to exhibit prowess, and these efforts have been continued under a pressure that seemed to forbid any chance of encouragement. This element of success we were not favored with for many years; but let

us view the outlook of to-day, let us see if we have not now a right to feel encouraged, and to believe that the tide, having reached its lowest ebb, is now on the flood on which we may rise to the position we once held.

The first and most important consideration for a Navy are ships! A reference to our Navy List shows a beggarly account. What encouragement have we for the future? We have much encouragement, and I will trace with historical precision the progress that has been made, slowly indeed but surely, in this direction.

The origin of the effort dates from June, 1881, when the Hon. William H. Hunt, Secretary of the Navy, appointed an Advisory Board to consider and to report on the need of appropriate vessels for the Navy. This board, styled the first Advisory Board, decided that for all purposes of "surveying, deep-sea sounding, protection and advancement of American commerce, exploration, the protection of American life and property endangered by wars between foreign countries, and service in support of American policy in matters where foreign governments are concerned," and for providing a "reserve of sufficient strength to maintain the effectiveness of the fleet," the United States Navy should comprise 70 unarmored cruisers.

The Board in its report of November 7, 1881, stated that there were 32 vessels in the Navy fit for service. The required 38 vessels were classed as follows, viz.:

Two first-rate steel double-decked unarmored cruisers, having a displacement of about 5873 tons, an average speed of 15 knots, and a battery of four VIII.-inch and twenty-one VI.-inch guns; cost $3,560,000.

Six first-rate steel double-decked unarmored cruisers, having a displacement of about 4560 tons, an average sea speed of 14 knots, and a battery of four VIII.-inch guns and fifteen VI.-inch guns; cost $8,532,000.

Ten second-rate steel single-decked unarmored cruisers, having a displacement of about 3043 tons, an average sea speed of 13 knots, and a battery of twelve VI.-inch guns; cost $9,300,000.

Twenty fourth-rate wooden cruisers, having a displacement of about 793 tons, an average sea speed of 10 knots, and a battery of one V.-inch and two 60-pounders; cost $4,360,000.

In addition to these cruisers, it was recommended to build five steel rams of about 2000 tons displacement, and an average sea speed of 13 knots; cost $2,500,000.

Five torpedo gunboats of about 450 tons displacement, and a maximum sea speed of not less than 13 knots, and one heavy powered rifled gun; cost $725,000.

Ten cruising torpedo boats, about 100 feet long, having a maximum speed of not less than 21 knots an hour; cost $380,000.

Ten harbor torpedo boats, about 70 feet long, having a maximum speed of not less than 17 knots per hour; cost $250,000.

The Board stated that "iron-clads are absolutely needed for the defence of the country in time of war," but as its orders were to recommend means of providing for the present "exigencies of the Navy," it considered this type outside of the category of vessels it was ordered to consider.

In the naval appropriation bill approved August 5, 1882, authority was given to build one each of the first two types enumerated above, and an Advisory Board (the second) was provided to advise and assist the Secretary of the Navy in all matters relating to their construction, and "to prepare plans, drawings and specifications of vessels, their machinery and armament, recommended by the late Naval Advisory Board not authorized to be built."

The second Advisory Board was organized November 13, 1882, previous to which there had been issued from the Navy Department notice and advertisements concerning the construction of the two steel cruisers inviting "all engineers and mechanics of established reputation, and all reputable manufacturers of vessels, steam engines, boilers or ordnance engaged in the business, all officers of the Navy, especially naval constructors, steam engineers and ordnance officers, having plans, models or designs of any vessels, or of any parts thereof, of the classes authorized by the Naval Appropriation Act of Congress of August 5, 1882, to submit such plans, models and designs to the Naval Advisory Board directed to be organized by the Secretary of the Navy, under the provisions of said act, for his advice and assistance in designing and constructing said vessels, in order that the same may be examined by said Board in accordance with the provisions of said act."

The Board issued a circular November 25, 1882, suggesting the general features for the larger vessel authorized to be built for the guidance of those proposing to submit plans.

The Board recommended to the Secretary of the Navy, November 21, 1882, that, in addition to the two cruisers already authorized to be built, there should also be constructed two of the ten second-rate

single-deck steel unarmored cruisers recommended by the first Advisory Board; also one dispatch boat.

On January 2, 1883, the Secretary of the Navy recommended to Congress (in accordance with the advice of the Advisory Board) the construction of one steel cruiser of about 4000 tons displacement, three steel cruisers of about 2500 tons displacement, one dispatch boat of 1500 tons displacement, and one cruising torpedo boat, to cost $38,000. The largest cruiser previously authorized was omitted for sufficient reasons, as she could not be built on the sum appropriated, and it was not considered judicious to build so large and expensive a vessel, which is not required, and which would be very expensive to retain in commission.

On February 1, 1883, the Board submitted general features for a 4300 tons cruiser, and on February 5, 1883, the Secretary of the Navy issued the same to ship builders and engine builders in the United States likely to make proposals for construction.

Congress, in the Naval Appropriation Bill approved March 3, 1883, provided for the construction of one cruiser of 4500 tons displacement (Chicago), two of 3000 tons displacement (Atlanta and Boston), and one dispatch boat of 1500 tons displacement (Dolphin), a portion of the estimated cost being voted at that time, and the balance being provided in the temporary half-year appropriation for the Navy approved July 7, 1884.

The Secretary of the Navy in his report of December 1, 1883, recommended, in accordance with the advice of the Advisory Board, the construction of seven additional steel vessels, viz.: one of each of the three types already under construction by the authority of Congress, and in addition to them, two heavy and two light armed gunboats. The consideration of a bill introduced in Congress in accordance with this recommendation produced an investigation by a Senate Committee, the evidence given at which showed that, with the exception of two of the officers summoned, the Advisory Board had the confidence of the Navy.

This bill failed to pass the House of Representatives. The debate upon it in the Senate was very thorough, and showed that, in that chamber party lines were yielding to what was felt to be a national question.

In the act making appropriation for the Navy, approved March 3, 1885, Congress authorized the construction of four additional vessels, two of not less than 3000 nor more than 5000 tons displacement, costing,

exclusive of armament, not more than one million one hundred thousand dollars each; one heavily armed gunboat of about 1600 tons displacement, costing, exclusive of armament, not more than five hundred and twenty thousand dollars; and one light gunboat of about 800 tons displacement, costing, exclusive of armament, not more than two hundred and seventy-five thousand dollars. This bill was passed during the last hour of an expiring Congress, and a line introduced in the House provided that the construction of these vessels should be under the direction of the Navy Department, not subject to the supervision of the Advisory Board. The general features and preliminary plans and calculations have been made for these vessels by a special board on additional vessels, and they are now in the hands of the Bureaus, who are preparing designs on which bids can be made if proposals are issued for their construction by contract.

We thus see that notwithstanding the apathy into which we had fallen, notwithstanding the more serious obstacle of party rivalry, whether with an Advisory Board or without an Advisory Board, the Navy can count on an addition of seven steel cruisers of modern construction, and one dispatch boat as a nucleus for the new navy. The coming year will see four of these vessels completed, and it may be that the year following may launch the four additional vessels; and have we not a right to believe, that the inertia of rest being overcome, and the energy of motion having been communicated, the pressure of the wave of public opinion will grow in force until it will come to be a recognized necessity to make a yearly appropriation for the increase of the Navy? I think we have a right to believe it. We know that public opinion is with us, the individual legislator will agree to the necessity of the increase; it only remains for the rivalry of parties to be suppressed in the face of this national question, and the signs are greatly in favor of this devoutly wished-for consummation.

It will be noticed that the Act of Congress which originated the first action in this matter was founded upon the recommendation of the first Advisory Board, and it is natural to suppose that the report of that Board will be referred to in future steps that may be taken, and if later experience does not suggest modifications, that they will form the basis for future action. We may thus conclude that the number of vessels indicated by that Board as sufficient to perform the duties of a navy in time of peace will be adhered to, and that seventy unarmored cruisers of steel will in course of time be added

to the Navy list. I count the whole number of cruisers of steel, because, even at a much faster rate than that at which we propose to build, our present supply of wooden ships will have entirely disappeared before that number will be completed.

It will also be noticed that the first Advisory Board interpreting its instructions ("to provide for present exigencies of the navy"), not to apply to armored vessels, made no recommendations as to the construction of such vessels, merely noting that "iron-clads are absolutely needed for the defence of the country in time of war." It seems to me that this is a weak position for us to continue to hold, that is, if the practical working out of the idea is to postpone the construction of armored vessels until we shall have provided ourselves with the seventy unarmored cruisers needed for current use. This is a short-sighted view to take of the matter. There is no good reason why the building of both armored and unarmored vessels should not be prosecuted at the same time; in fact, I think, it can be shown that the construction of the two classes of vessels at the same time would prove ultimately to be economical in result. But, apart from the matter of cost, does it not seem absurd to confine our preparations only to what is required in peace when it is openly recognized that the *armored* vessels are indispensable in time of war?

ARMORED VESSELS.

This view was actually taken of the subject by Senators when the bill for additional vessels was under consideration in the Senate in 1884. One Senator who declined to vote for the additional unarmored cruisers declared that he would vote fifty millions for vessels capable of contending with first-class iron-clads and of resisting modern artillery.

Taking advantage of this offer of the Senator, and with the earnest desire to give him a chance to vote his fifty millions, I addressed a letter to the Secretary of the Navy, which I place here on record as I find it embodies ideas and recommendations which I still hold to be sound. The letter was as follows:

NAVY DEPARTMENT, WASHINGTON, *April* 11, 1884.

The Honorable W. E. CHANDLER,
Secretary of the Navy.

SIR:—Referring to the debate in the Senate on the amendments to the Naval Appropriation Bill, objection is raised by some Senators to granting additional vessels to the Navy on the ground that the cruisers asked for are not of such

fighting quality as to match armored vessels of other nations, the inference being that if a bill were presented for the construction of an armored vessel it would meet with their approval.

The first Advisory Board was fully sensible of the need of armored vessels for the Navy, but in consideration of the great need of cruisers to carry the flag abroad it recommended as the first step in rehabilitating the Navy the construction of vessels to supply this, the most pressing want of the service. Construction of armored vessels was confidently expected to follow in due order after a sufficient number of unarmored vessels should have been built to form a cruising force. It seems apparent that the building of armored vessels, and of unarmored vessels, was not proposed to be carried on simultaneously, from a disinclination to call for very large appropriations.

For the purpose of conforming to the implied desires of Senators for armored ships, and from the fact that there is no doubt of the need of them, I respectfully recommend that the programme laid out by the first Advisory Board be so far departed from as to admit of having one armored vessel under construction constantly, even while the work of providing cruisers is in progress.

The length of time required for such constructions is from three to five years. They are very costly, and will involve much study and careful preparation; besides the selection of a type will be a matter requiring much deliberation.

In relation to the last point, the selection of a type, I submit general dimensions and some particulars of two armored vessels which represent the most advanced ideas of the present day. One of these would, most probably, be the character of the vessel that would be recommended by such a body as the Advisory Board.

H. B. M. Ship Imperieuse, not yet completed, was commenced in 1881. She is called an armored cruiser, and is intended for sea service on foreign stations where fast unarmored ships may have to be opposed, and where second-class ironclads may have to be engaged. Her dimensions are as follows:

Length,	315 feet.
Beam,	61
Draught,	25
Displacement,	7400 tons.
I. H. Power,	8000
Speed,	16 knots.

The battery will consist of four 9.2-inch guns, each mounted in an armored barbette, and six 6-inch guns in broadside. The barbettes are arranged one forward and one aft, and the others abreast of each other at the sides amidships; the heavy guns are thus situated at twice the height from the water that they would be in a turreted vessel, and can be fired three together in any direction. The speed and armament here described does not greatly exceed that of the Chicago, but the difference in displacement of 2900 tons admits of the following armor:

Throughout the length occupied by the machinery and boilers (139 feet), the sides are protected by ten inches of compound armor for a depth of eight feet,

the deck over this is one and a half inch thick; bulkheads of plating eight inches thick run athwartship at the forward and after extremities of the side armor, thus forming a citadel enclosing the machinery and boilers. Forward and abaft the citadel, at the level of its lower edges, extends a protective deck three inches thick, sloping downwards to the sides, as in the Boston and Atlanta. The barbettes are seventeen feet in diameter, and are armored with eight inches of steel, which protects the machinery for turning, elevating and loading the gun, and an armored chute leading to below the armored deck makes the passage of ammunition safe and rapid. The pilot tower is protected by ten inches of armor.

Contrasting the protection afforded by the armor above stated with the vulnerability of the Chicago, the advantage of the increased displacement of the Imperieuse becomes apparent.

Another type of vessel that would come up for consideration is the turreted ship Riachuelo, just completed for the Brazilian Government by an English firm on the Thames. Her dimensions are as follows:

Length,	305 feet.
Beam,	52
Draught,	20
Displacement,	5700 tons.
I. H. Power,	6000
Speed,	16 knots.

The armament consists of four 9-inch guns in two turrets, and six 6-inch guns on the upper deck. There is an armor belt of eleven inches thickness covered by a two-inch deck, and the turrets have ten inches of armor.

The armor protection is by no means so complete as that of the Imperieuse, nor is the arrangement of the battery so effective, but on the other hand, the speed is greater and the displacement is 1700 tons less.

These instances are cited to show that a Board cannot, except after the most careful study and examination, decide upon even the size and general dimensions of an armored vessel best suited for our purposes; therefore, in suggesting the form for an Act of Congress which shall the best carry out the recommendation I make in this communication, and estimating the time for completing the vessel as three years, I would propose that the authority should be given somewhat in the following form:

For the construction of one armored vessel of not exceeding 7500 tons displacement, one million dollars; such vessel to be constructed under the same conditions as prescribed for the construction of the steel cruisers, and its armor and armament procured, at a total cost not to exceed two millions five hundred thousand dollars.

Very respectfully,

E. SIMPSON, *Rear-Admiral.*

This letter was communicated to Senators and found its way into the press. In these days of rapid development we cannot confidently count on adhering for any length of time to what we approve

to-day. The development is still going on, and the advance already made may constrain us to go a step further, but in this matter of type of armored vessel I think we can claim an exception; for I find no reason to change or modify what I wrote in April, 1884, and I am inclined to think that the question is definitely settled between the casemate, barbette and turret. The first type of seagoing armored vessel naturally had the armor disposed on the broadside. The movement commenced in France, in 1858, was followed by England, and continued until their formidable fleets were equipped in this manner. In 1868 the casemate or central battery armored vessels appeared, represented in England by the Hercules and the Sultan, and in France by the Océan, the armor being limited to an armored belt at the water line, and the protection of the battery and engines by an armored casemate. In the French ship, however, in addition to the casemate for the central battery, there were introduced four barbettes, one at each of the four corners of the casemate, armored with six and a half inch plates, and mounting in each a gun of fifteen and a half tons weight. The Marengo, Suffren and Friedland quickly followed the Océan, with batteries and armor arranged in a similar manner. Since that time the construction of casemate ships has been gradually discontinued in France, and the barbette is now the adopted type, the armor consisting of a water-line protection and an armored deck covering all vital parts, while the vertical tubular passages for the passage of ammunition are strongly protected. Apart from other reasons this arrangement of armor conforms to the necessities arising from the introduction of guns of much increased calibre and weight.

In 1872 the English Admiralty built the Téméraire, in which two guns were mounted en barbette in connection with a central battery; but they did not fully adopt the type until 1882, when the Collingwood was launched. It is evident that the advantages are fully recognized now by the English authorities, for a large number of vessels of this type are now under construction. I cite here the names and displacement of those which are being rapidly pushed to completion, viz.:

Collingwood,	of	9,150	tons displacement.
Imperieuse,	"	7,390	"
Warspite,	"	7,390	"
Howe,	"	9,600	"
Rodney,	"	9,600	"
Camperdown,	"	10,000	"
Benbow,	"	10,000	"
Anson,	"	10,000	"

This list is sufficient to prove that England thinks the barbette type of armored vessel has come to stay; such action implies no doubt of the efficiency of the system.

The monster ships of Italy, the Lepanto and the Italia, of 13,898 tons and 13,550 tons displacement, are of the barbette type, and that nation has now under construction three additional vessels of the same type, viz.:

The Ruggiero di Lauria . . .	of 10,045	tons displacement.
Francesco Morosini . . .	" 10,045	"
Andrea Doria	" 10,045	"

Russia has ten barbette ships on her Navy list, and is continuing the construction.

In recommending, then, as I do, the barbette type of ship for our sea-going armored vessels, I think I have the experience of the world to sustain me. No more positive proof can be given of the superior advantages of the system than the practical demonstration given by the nations cited of their faith in it. There is no saving of weight of armor, but the disposition of the weight is radically different from what it is in a ship with casemated battery, and is better arranged to protect all submerged parts of the vessel, the armor deck being extended aft to the stern, thus covering all parts of the steering apparatus, while forward it gives most valuable support to the ram. The only question that could arise in selecting a type would be between the barbette and the turret system, but for sea-going purposes the increased height in the disposition of the battery given by the barbette, as compared with the position of the battery in a turret ship, must be recognized as an advantage hardly to be equalled by any others that the friends of the turret could advance for their type. And even for coast defence, or for harbor defence, the barbette system presents so many advantages that it seems to be possible for it to be substituted for nearly all purposes where the closed turret is now used. This probability increases with the increase of calibre of the guns, for it must be remembered that with the turret system the port is very near the deck, and the blast from the discharge of a 100-ton gun is something tremendous. There is a dearth of experiments on the effect of blast at the muzzle of a gun. They are much needed to assist in the investigation of this very point.

Having stated my conviction that there should be no delay in commencing the construction of armored vessels, and having given you

the reasons for my preference for a particular type of vessel, and believing that type is sufficiently established by the experience of the world to justify us in accepting it as a standard, I submit to you now a few of the general features of such a vessel as I would advise. It is not exclusively my own design; it is evolved from the deliberations of a body of earnest men who considered the question carefully.

I premise by saying that we are restricted as to the displacement of our armored vessels. It is impossible for the United States to utilize such a vessel as is ranked as first-class by other nations; we have not a sufficient depth of water on our bars. It is a question of draught of water. Again, the dimensions of the vessel must be governed by the size of our dry docks; that building at Mare Island is the only one that would admit a first-class ironclad, while those at Boston and Norfolk limit the extreme breadth to about 58 feet. Here is an absolute limit set on two dimensions; and, confining the length to near 300 feet, in order to ensure handiness, it will be found that, combining these with the two other governing qualities of large margin of stability and space for well protected machinery, the maximum displacement will be fixed at about 7000 tons.

The principal dimensions of the hull would be:

Length,	320 feet.
Breadth,	58 "
Mean load draught,	23 "
Load displacement,	7300 tons.
Maximum speed in smooth water,	16 knots.

The battery should consist of four X.-inch B. L. R. guns, each mounted *en barbette* within a fixed turret nineteen feet in diameter, one located on each side amidships, and the other two on the middle-line of the upper deck, one forward and one aft; the guns to be protected from machine fire by revolving hoods of 4-inch steel, the axes of the guns of the side turrets to be twenty-one and a half feet, and those of the middle-line turrets twenty-three feet above the load-water line.

Four VI.-inch B. L. R. guns should be mounted on the upper deck protected by circular revolving 4-inch steel shields.

A suitable secondary battery should be carried, consisting of Hotchkiss single-shot guns of 57 and 47 millimeters, and revolving cannon of 37 millimeters, and Gatling guns.

The allowance of ammunition should be 100 rounds for each

X.-inch and each VI.-inch gun, 1500 rounds for each large Hotchkiss gun, and 800 rounds for each 37 mm. gun.

445 tons should be reserved for the weight of ordnance.

There should be separate magazines and shell rooms for each turret.

The hull should be built of mild steel with brass stem, stern post and rudder should be cased with wood to the height of the main deck and sheathed with copper.

The armor protection should consist of a belt eight feet in depth, three and a half feet above and four and a half feet below the load line, extending throughout the length of 150 feet occupied by the machinery and boilers and central magazines, the ends being enclosed by athwartship bulkheads nine inches thick, the thickness of the side armor being ten inches from the top to one foot below the water line, and tapering thence to five inches at the lower edge of the belt.

The armor on the barbette turrets should be seven feet deep and eight inches thick, on the pilot tower five feet deep and six inches thick, on the hoods to barbette guns four inches thick, and on the ammunition tubes to turrets four and a half inches thick.

At the level of the top of the armor belt and throughout its extent there will be an armored deck two inches thick, and before and abaft the armor belt the armor deck is continued to the extremities at the level of the lower edge of the armor belt, or four and a half feet below the load-water line amidships, sloping at the sides, and at the bow to strengthen the ram.

The ship will have such sail power as can be carried on two steel lower masts, to be fitted to carry circular tops for machine guns and extra gaffs or derricks for hoisting torpedo boats.

Provision should be made for carrying and launching two sixty feet torpedo boats in addition to the usual allowance of boats, and the vessel should be designed with reference to being ultimately fitted with above-water launching gear, in four places, for an automatic fish torpedo.

The coal supply at load draught should be 500 tons, with bunker capacity for 800 tons; and arrangements should be made to stow provisions for 400 men for 90 days, and other stores for the usual periods.

The engines and boilers should be capable of developing 7500 I. H. P. in the aggregate, during a six hour full power trial, the fuel to be the best semi-bituminous coal.

The fire rooms should be made air-tight, and fitted with centri-

fugal fans of sufficient capacity to maintain therein a pressure above the atmosphere equivalent to a column of 1½ inches of water.

There should be twin screws actuated by two sets of three cylinder direct-acting vertical compound engines, the two engines complete being contained in water-tight compartments, separated by a longitudinal middle line bulkhead.

It is proposed that the steam should be supplied by twelve three-furnace cylindrical boilers, having an aggregate grate surface of 900 square feet.

The total weight of the machinery, boilers and appurtenances, including water in boilers and condensers, all fittings, tools, stores, spare machinery, ready for sea, should not exceed 1400 tons.

This is the vessel recommended to the Secretary of the Navy by the Advisory Board, "a part of which I was."

I believe this ship to be a sound basis to work on. Controlled as we are by nature in the displacement to which we can attain, and satisfied as I am that we have reached the type of vessel that will remain permanent, I see no reason why we should delay commencing the construction of our sea-going armored fleet. This fleet should consist of ten vessels, forming the outer line of defence of the coast in war, always available for operating abroad either in peace or war, and affording a school of practice and instruction in peace to prepare us for war.

COAST DEFENCE VESSELS.

But in addition to sea-going armored vessels, we are sadly deficient in vessels for coast or harbor defence. We have sixteen ports on the Atlantic coast to guard, besides San Francisco and other points on the Pacific coast. For this purpose we require a fleet of heavily armed and armored turreted, or barbette vessels, to cover the coast as a second line of defence, and to concentrate at any time at the point attacked. These vessels should be of moderate speed, but as near invulnerable as possible, and armed with batteries that should be irresistible. Two classes of this type would be needed in order to provide for operations in shallow as well as in deep water. With the experience of others, and our own, we could easily determine upon the general features of suitable vessels for this service. The distinct duty for which these vessels would be designed would be to engage armored vessels; consequently all other considerations would have to yield to protection of the hull and the power of the guns. The heavier class should carry guns of 100 ton weight, and the lighter

class guns of, say, 50 tons weight, and I consider that 25 of such vessels are needed to complete the second line of defence. The lightly armored and indifferently armed monitors that we now have on the Navy list can be utilized in the third line of defence until more suitable vessels can be provided, and, in concert with systems of torpedoes, will serve as the defence for harbors and mouths of rivers.

I think that it is very desirable that the construction of the coast defence vessels should go on at the same time with that of the unarmored and armored cruisers. There is no sufficient reason for delaying in either case. As all will be ultimately needed, it is poor policy to delay the work on one until it is completed on others. The navy-yards are idle; no more suitable work can be found for them than the construction of armored vessels. The ship-building interests of the country are at standstill; no more appropriate or congenial work can they find to fill up the interval of stagnation than the building of unarmored cruisers. The work would give occupation to tens of thousands of mechanics and laborers, and new industries would be started in the country.

In this connection it is proper to put prominently to the fore the absolute necessity of completing at once the four double-turreted monitors, which lie in an unfinished state at the yards of the contractors. These vessels have been assailed for one reason or another, and the effort has been made to impair confidence in them. I know not how far these efforts have influenced the mind of the Navy, but in order to clear up any doubts that may exist I will quote from a report made by the Advisory Board, in October, 1883, in which the Board states its reasons for recommending the immediate completion of the ships.

The Board says: "It is our opinion that it would be wise and expedient to finish the vessels at once, and for the following reasons, viz.:

"1st. The hulls as they are at present are of excellent workmanship, fully up to the present standard condition of iron-ship construction whilst the flotation of the Puritan and the behavior of the Miantonomoh at sea confirm the correctness of the calculations of the designs.

"2d. It is easily possible to complete the vessels by taking advantage of the recent developments in armor, guns, and machinery, without making any radical changes in the designs, so that their

speed, endurance, battery power, protection, and sea-going qualities shall be fully equal to those of any foreign ironclad of similar dimensions designed previous to 1879.

"3d. The vessels may be finished so as to develop all the above-mentioned advantages without making their total cost when completed in any way exorbitant compared with the results obtained; again, the interests of our seacoast defence require a force at least equal to that which would be represented by these vessels.

"We take the liberty of calling your attention to a certain erroneous impression which now exists with regard to these vessels. In one of the official reports on these hulls a doubt was thrown upon the correctness of the calculations of the Puritan. This doubt has spread in the public mind until it includes all the ships. The actual flotation of the Puritan and the Miantonomah proves beyond question not only the reliability of the calculations, but also that the hulls of these vessels are lighter in proportion to the total displacement than those of any ironclad low freeboard hulls afloat, with but two exceptions.

It has been the unfortunate custom, in arguments as to the value of the results to be obtained, to compare them with such foreign ships as the Inflexible and Duilio to the evident disadvantage of the monitors, no account whatever being taken of the fact that these vessels are double the size of the monitors. If these hulls be compared with foreign ones of similar dimensions no such disparity will appear."

Here I close the extract from the report of the Advisory Board. This statement should set at rest all doubts as to the efficiency of the vessels, and the work should be resumed on them with view to their completion at the earliest practicable moment. It is well to add that five other Boards have made similar reports recommending the completion of the vessels.

These vessels, with the exception of the Monadnock, have their machinery in place, and are finished as to their hulls, except the interior fittings, side armor, and turrets.

The estimated cost to complete them is as follows:

Puritan, ...	$1,141,481
Terror, ...	785,267
Amphitrite, ...	797,563
Monadnock, ...	1,074,069
Total to complete, ...	$3,798,380

TRAINING VESSELS.

Before dismissing the subject of ships, I should mention a serious want of the Navy in the lack of suitable sailing vessels for training boys and for the exercise of naval cadets in practical seamanship. The system for training boys for the Navy is now established on a basis that seems to work satisfactorily, but, singular to say, the article that is of the very first consequence is that in which we are the most deficient. The few remaining sailing vessels of the Navy are devoted to this duty, but they are so old and are so constantly in need of repair that in a year or two they also will be withdrawn from service. At best, however, they are inefficient vessels, particularly in consequence of the size of their spars and weight of sails; they are too large and heavy to be handled by boys. This objection also obtains in the case of the vessels assigned to the naval cadets. The Naval Academy and the Training School should both be provided with ships of the Dale class, composite built, full-rigged. Six of these vessels should at once be provided. They would be launched in a few months at a cost of about $175,000 for each.

Amid the pressure of advanced ideas and the earnest efforts of progress, the basis of a seaman's education should not be forgotten. Seamanship must not be neglected, and it is at an early age that the knowledge must be acquired. All old officers will agree that they learned their seamanship during their midshipman's career. Learned while young, the knowledge will remain for life and will form the source from which we can draw to our aid in all other branches. There is nothing like it for developing the power of resources and the invention of expedients. A seaman is never helpless. If one means fails he will try another. He can work without tools. The sailing of a ship, the handling of spars, the trimming of sails, the hoisting of weights, the stowing of a hold, all give him an instinctive knowledge of practical science, and above all, a seaman trained to a sailing ship acquires a degree of personal confidence which can come from no other source. We may say that we have now no sailing vessels in general service, hence the necessity of more earnest training in this branch before an officer or man is launched into the regular service. A ship combining sail and steam is not a suitable vessel for training purposes for officers or men. Sailing ships, pure and simple, must be applied to this use, or the education will be sadly deficient.

GUNS AND GUN FOUNDRIES.

The gun as the thing of next importance merits attention. How do we stand in respect to this important element, which stamps the character of the ship, and to the efficient working and handling of which all the designs of the constructor and engineer must be accommodated and made subservient?

We are fortunate in one very important point in the matter of the gun wherein our delay in commencing work has proved of advantage to us. We have adopted a type of gun which all agree is the best. There is no difference of opinion among us. We have received the Vavasseur method of construction as the one superior to all others, and we are confirmed in our judgment by that of other nations who, having embarked in other systems, have now abandoned them and accepted that of Mr. Vavasseur. Woolwich has abandoned wrought-iron, and the efforts of the steel manufacturers of England are now put to a severe test to supply steel in masses of sufficient size to answer the demand, and what is now called the Woolwich gun is the Vavasseur gun, so determined by the Ordnance Select Committee. The Krupp construction is also modified so as to include the Vavasseur long jacket; and the French, though yet somewhat divided between the plans of General Dard of the Marine Artillery, and Colonel de Bange, on whose ideas the army guns are constructed, are approaching the Vavasseur standard. The guns that we see slowly progressing at the Washington navy-yard are Vavasseur guns pure and simple.

You all know how much the matter of the gun has occupied my thoughts, and though, for reasons beyond my control, I have not been privileged to direct in any way this arm of the service, you can readily understand what a gratification I enjoy when I see the ideas that I advanced many years ago being carried out and executed by the present accomplished Chief of the Bureau of Naval Ordnance, an officer well fitted to carry forward the work, and with time before him on the active list to perfect it. I sympathize with him in the extra work imposed upon him in having to invent expedients for manufacture instead of having at his disposal a suitable plant. I will review the steps that have been taken to supply this deficiency.

By Act of Congress, approved March 3, 1883, there was established a mixed Board of Army and Navy officers called the Gun Foundry Board, whose duty it was to take into consideration and to report on

the best means of making ourselves independent in the matter of manufacturing modern cannon. It seemed to be a foregone conclusion with the framers of the bill, that the gun to be manufactured was to be of steel, and that this new manufacture could not be performed by the means at the disposal of the country, which had, up to the time of the Act, manufactured guns only of cast-iron. The Board was not called upon to deal with the matter of gun construction; its province was to recommend suitable sites, tools and all apparatus for the manufacture of guns, and to submit the approximate cost. In the early part of its labors the Board could derive no assistance whatever from our own steel manufacturers. They had not taken the matter into consideration, they possessed no tools calculated to do the work required, none such were made in the country, and the capacity of their furnaces and forging apparatus was insufficient to cast the masses or to forge the ingots required. The information required was gained abroad, and I do not propose to repeat to you the contents of the report made on the subject to Congress. The report has been widely circulated in the Navy, and it attracted much attention from the steel manufacturers at home — so much so as to remove the wall of partition that seemed to exist between them and the Board when they were first approached, and to cause them to come forward and assist the Board in the preparation of its supplementary report, which was called for in order to present in detail a method by which the recommendations of the Board in the original report could be made a practical thing. The plan proposed by the Board for putting in execution its recommendations is the basis devised by the business minds of manufacturers on which they will be prepared to offer bids if proposals are issued by the Government. It is on the successful working out of this business arrangement that our hopes of speedy re-armament depend. I will point out the difficulties that encompass the subject, and you then can judge what encouragement we have to hope for a supply of modern guns.

You are aware that the Gun Foundry Board decided that there should be no government foundry. The share of the work of the Government was limited to that comprised in gun factories, one for the Army and one for the Navy, in which is done the finished-boring and turning, rifling, fitting breech apparatus, and assembling parts; all work of foundry proper, including casting, forging, rough-boring and turning and tempering was relegated to the private industries of the country. There is no question of the inability of any foundry in the United States

to perform the work required. Mr. Sellers, of the Midvale Works, near Philadelphia, has succeeded in supplying some tubes for VI.-inch guns, and the Cambria Works, at Johnstown, Pa., have undertaken to make some hoops, but this is all that can be achieved by their limited equipment. The limitation in the case of the Cambria Works applies only to its forging, boring and turning apparatus. It possesses furnace capacity for casting the largest ingots required for cannon. A manufacturer undertaking the work of supplying the material for all classes of guns must erect a suitable plant.

The cost of the plant is stated as follows, taken from the report of the Gun Foundry Board:

Casting,	$250,000
Forging (hydraulic press),	150,000
Rough-boring and turning,	210,000
Tempering,	50,000
	660,000
Additional cost if liquid compression be adopted,	175,000
	$835,000

The cost is based upon prices abroad; in round numbers the manufacturer must expect to invest one million dollars in a plant. He cannot expect to do this unless he is satisfied that it can be kept in operation for a certain time sufficient to remunerate him.

It is also necessary that the time during which the plant would be employed should be continuous, and this must be assured, for the purpose of avoiding the uncertainty attending annual appropriations which depend upon the will of each Congress to be continued or withheld. It thus becomes necessary that a lump sum should be secured for this purpose, which would stand for a guarantee for the execution of such contract as might be made. The question, then, was what sum of money was necessary to appropriate in order to secure the contractors, and assure a supply of ordnance for the government.

The necessary outlay being so large, and the Government desiring only to treat with the most responsible parties, it seemed reasonable to suppose that those embarking in the work would be very few in number, probably but two establishments would take it up, one for the Army and one for the Navy. On this supposition the calculation was made on a unit of works, that is, to find the amount sufficient to induce one establishment to go into the business.

An output of 2000 tons of forgings per year was taken as a basis for production. It was estimated that the average price of the steel would be twenty-five cents per pound, some more, some less; this gave $559 as the cost per ton of 2240 pounds. At this price the cost of the yearly production of 2000 tons would be $1,118,000. Allow, as a fair profit to the business, 15 per cent. of this amount, and we will have for yearly profit the sum of $167,700; and continuing this for six years and a half, the profits will amount to $1,090,050, a little more than the amount of the original outlay. The lump sum required to be appropriated for this purpose would be six and a half times the amount of the cost of the yearly production, or $7,367,000. This agrees with the report of the Gun Foundry Board, in which you will notice that the sum mentioned as necessary to be appropriated is $15,000,000, one-half for the Army, one-half for the Navy, that is $7,500,000 for each arm of the service, such amount being sufficient to secure the supply of material, at the same time assuring the contractor of a fair remuneration. This explains the figures given in the report of the Board.

I call your attention now to the wording of the proposals recommended to be issued for this work. "Said proposals shall divide the steel required into two lots. Each lot shall include all the parts for one-half of the number of guns for each calibre; each bid must include all of a lot or lots."

You see that, though the calculations for cost were made on the basis of a unit of works, there is nothing in the proposal favoring a monopoly in the work. Several manufacturers may bid, and the work be thus divided; this would result only in a more remote remuneration for their outlay. But the Board takes the precaution to require that in bidding for a lot or lots the contractor shall undertake to supply all the parts of the lot for which he bids; this ensures that his works shall be thoroughly equipped for the work he takes in hand. It would be a want of foresight to arrange the lots so that a few small establishments could bid for all the small parts, leaving only the heavy work to be done by those establishments who are willing to bear the expense of erecting a large plant. It is all important to the country as a means of national defence that these large plants should be erected, and all means should be taken by the Government to encourage the work; thus, by requiring all parts of the gun material to be included in a lot, an advantage is given to those establishments which propose to make their plants complete.

Supposing contracts to be made for the material, you may accept the period of delivery, stated in the Board's recommendations relative to proposals, as deserving of all confidence. It required that "Each bidder shall agree to deliver yearly a specified quantity of each calibre, the time of delivery of the smaller calibres to commence at the expiration of not more than eighteen months, and that of the largest calibres at the expiration of not more than three years from the date of the acceptance of the contract." This estimate is determined by positive information on the time necessary to duplicate the best tools now in use at the largest foundries abroad. The supply of the plants is an affair that would be entirely in the hands of the manufacturers themselves, who would naturally consult their own interests in equipping their establishments; it would be for them to choose between adopting tools of approved utility purchased abroad or encouraging home manufacture and risking failure by undertaking the work with the first productions of a new industry. There can be little doubt that, being bound by contract as to the time of delivery of the production of their works, they would wish to commence operations with tools of well-known capacity; the home manufacture would naturally follow, and would, no doubt, improve on the standard, but it would be a great risk at the inception of the manufacture to work with untried implements. The time for delivery of the productions of the foundries is predicated upon the supposition that the first tools used will be bought abroad, and upon the known capacity of such tools to turn out a certain amount of work in a given time. On any other basis, the time of delivery would have to be indefinitely extended, in fact there would be no data on which to make a calculation. So much for the foundry work.

It is manifest that the delivery of the tempered material for guns, rough-bored and turned, is of no avail unless the gun factories are prepared to take the parts as they arrive, and to smooth-finish and assemble them. These indispensable establishments must be organized while the material is in course of manufacture.

The cost of a plant for a gun factory is given as follows by the Gun Foundry Board:

Guns up to VI.-inch calibre, ...	$50,000
" from VI.-inch to XII.-inch calibre, . . .	150,000
" " XII.-inch to XVI.-inch calibre, . .	350,000
Buildings and shrinking pit, ...	350,000
	$900,000

"Three years will be required to complete the tools, construct the shops, and establish the plant."

This period is intended to represent the time necessary to complete the factory, equipped for the fabrication of cannon of all calibres up to the largest available for warfare. The building and the tools required for the smaller calibres, including those for VIII.-inch guns, could be prepared in less time. The building, for example, could be erected in one year, and the smaller tools could be delivered and put in place in a year and a half, which, you will notice, is precisely the period of time required for the commencement of the delivery of the material for the smaller guns. Thus the time for the delivery of the material and the time when the factory would be ready to receive it synchronize, and if the authority to erect the factory be given at the same time as the contract for the manufacture of material the work will go on harmoniously from the commencement. It is evident that the two operations must be regarded as necessary parts of one transaction; one is of no practical use without the other. In the case of the gun factory, as in the case of the foundry, I have to state that the cost of tools is predicated on prices obtained abroad, and the time of their delivery on what is known as the period required for duplicating those in use in England, France and Russia.

I hope that the practical thoroughness of the report of the Gun Foundry Board is appreciated by the services. I make this remark before a naval meeting in order to point to our indebtedness to our brothers of the Army, with whom we share the credit of the work.

We thus see that, if during the approaching session of Congress, there should be enacted all the legislation necessary to equip the two arms of the service with modern ordnance, and if the steel manufacturers should respond to the proposals of the Government, it would not be before the early part of 1888 that we would be able to commence the fabrication of the smaller guns at the factories, and not until a year and a half after that that we would be ready to take in hand the guns of the largest calibre. It is very evident that, in comparing our chances of speedy acquirements of ships and guns, the ships are the more readily attainable. For their construction we have ship-yards whose plants can be readily supplemented with the additional tools that will be required; but for the fabrication of cannon we have yet to commence the erection of plants and to inaugurate the manufacture of the material. We have the satisfaction of knowing that, since the presentation to Congress of the report of the Gun Foundry

Board, a committee has been appointed in both houses to take into consideration the capacity of the foundries in the United States to provide steel for ships and guns, as well as the capacity of our ship-yards to construct modern ships of war. This action on the part of Congress is a step in the desired direction, and if time be found during the session for the deliberate treatment of national subjects, we may expect that some definite method for advancement may be matured.

ARMOR.

Another sign of encouragement is to be found in the establishment of the "Fortifications Board," on which the Navy is well represented by two members of this Institute. There can be no doubt that this Board will recommend that one line of the coast defence shall consist of armored turreted or barbette vessels, the construction of which would call for a large supply of armor plates. Here we see another powerful reason for the establishment of foundry plants.

If it shall be decided to commence the construction of armored vessels, and to face forts with armor plates, it will be necessary for the Government to make a definite selection between the steel plate and the plate of compound armor. The compound armor, again, is not all of one patent. The Cammel plate, consisting of a previously prepared iron plate on which the steel facing is cast, is all prepared in the rolling mill; the iron plate is rolled to dimensions, and, after the steel facing is placed, it is finished by passing through the rolls. With the Brown compound armor plate, however, the iron plate is prepared as before, but the steel plate for facing is also prepared separately, and this is forged under a hammer. The steel plate being then placed on the iron plate, separated from it by distance pieces, melted steel is poured into the space between the plates, thus welding the one to the other; it is finished by being pressed through the rolls. In this case we find a necessity for the heavy forging hammer or press. The steel plate as manufactured by Mr. Schneider at Le Creuzot is worked entirely under the hammer, is tempered and subjected to other treatment. My own judgment favors the steel plate. I think it more in the course of advanced ideas, and I am content with the results it has achieved in experiments; and the more experience we have in the manufacture, the more will we approach perfection in results. If the steel plate be adopted by the Government, we see how indispensable it is for us to be provided with large forging facilities, whether with the hammer or forging press.

I am aware that at Terre Noire, in France, it is claimed that a good steel armor plate can be cast which needs no forging, and I am under the impression that the same idea obtains at one of our own large steel establishments, but I have no confidence in such material, and I think that the first shot from a modern gun would dispel the illusion of those who entertain the idea. I accept as a fact that for the manufacture of steel armor plates there is required a heavy forging plant, and if we possess such facilities for forging our ingots for cannon we have secured apparatus that will be equally serviceable for treating armor plates.

An approximate calculation will give an idea of the amount of material that would be required for the purpose of the Navy. Supposing that the United States should undertake the rapid construction of an effective ironclad fleet, including armored cruisers and vessels for coast defence, the largest probable rate of construction would not exceed the completion of one armored vessel of 7000 tons displacement, and two of 5000 tons each year. This would require a total annual expenditure of seven and a quarter millions of dollars, and an annual supply of armor of about 3800 tons, including their armor for protective decks and protecting shields for light secondary batteries.

During the first year after the construction is commenced, not more than half this amount of money above estimated would be expended, nor half the armor required. This approximate estimate is made supposing that the amount of armor now carried by modern vessels will continue to be used. In addition to the above supply of armor for new ships, the completion of the double-turreted monitors now on hand would require an immediate supply of 3000 tons.

Nor must we forget the amount of material that would be required to *arm* the ships that I have proposed. There will be required for the batteries of the seventy unarmored cruisers, the ten armored cruisers, and the twenty-five coast-defence vessels about 7000 tons of *guns*, which we may roughly estimate at about 10,000 tons of forgings.

I give these estimates to illustrate the high figure to which the wants of the Navy swell. It is well that we familiarize ourselves with the idea of large masses of material and large expenditures of money; the rehabilitation of the Navy is a work of magnitude, and Congress and the people must be approached without disguise. The steel manufacturers may also recognize their opportunity, and find that their interests lie in supporting our efforts.

TORPEDOES.

Everything relating to torpedoes is legitimate work for the Navy and merits the close attention of this Institute. Although the stationary mine for the defence of the coast is relegated to the Army, yet it is a weapon which we may, either at home or abroad, be called upon to manipulate, and our instruction in it is very thorough at the torpedo station at Newport; but the movable torpedo is the one that more especially demands study and development from us. In seeking for indications of advancement in this field, the difficulties that surround it are impressed upon us by the paucity of the results. The essential requirements are perfect control of direction both vertically and laterally. The Whitehead torpedo is the only one that possesses these attributes sufficiently pronounced to justify its being issued as a war implement. The control of the movements of the torpedo is effected by means of two rudders, the one vertical, controlling the horizontal deviation, which must be permanently set at such an angle as experiments with each torpedo show is necessary to make it go straight, the other horizontal, regulating the immersion, which is actuated by a piston under air pressure governed by the hydrostatic pressure of the surrounding water. The principle on which the latter result is achieved is recognized, but the device itself is only known to the experts of those nations who have paid the price demanded for the information, and its nice adjustment is the result of multitudes of experiments, and the expenditure of large sums of money. The results seem to be very satisfactory, but the control over the lateral deviation of the Whitehead torpedo does not meet all the circumstances of service. I believe I am correct in stating that no confidence can be placed in the operation of it when discharged from the broadside of a vessel moving through the water. When fired ahead or astern the direction is sustained as originated, but its course is very erratic when projected under other conditions.

In this respect the torpedo of Captain Howell, of the U. S. Navy, is much the better equipped, for the power being stored in a fly-wheel revolving in a longitudinal vertical plane, its gyroscopic tendency makes it impossible for the torpedo to deviate from its original course in a horizontal plane. His device for regulating immersion is not yet sufficiently perfected to ensure the required action with certainty. This can only be done by repeated experiments, which must extend over considerable time and involve the expenditure of much money.

Thus far the Government has expended but a few hundred dollars to assist the development of this torpedo, but as its good points are the more appreciated the chance increases of securing liberal aid for experiments. We have good expert opinion for the belief that the Howell torpedo is the successful rival of the Whitehead.

But it is important to note the effects that have been produced by the introduction of the Whitehead torpedo. It has introduced an element into the calculations of war that interfere materially with the conclusions that had been reached on the equipment of ships.

The introduction of the weapon involved that of means to utilize it, and some ships were fitted with tubes from which it could be projected. The next step was the construction of very fast torpedo boats, assigned to ships capable of stowing them, which were expected to be launched at sea to assist in a naval action. The general adoption of this idea has led to the construction of larger vessels having increased speed, which, apart from the destruction they are expected to work by their torpedo attack on large vessels, are designed to act as torpedo boat catchers, and, in addition to their torpedo battery, are fitted for this purpose with a formidable supply of rapid-firing single-shot Hotchkiss and revolving cannon capable of perforating all parts of a torpedo boat.

The French style this type of vessel a "dispatch torpedo boat," and they are represented by the first one of the class called La Bombe, which was launched in August last at Havre. Eight vessels similar to La Bombe are now included in the official list. These vessels measure about 196 feet in length with a draught of water of about six feet, on a displacement of 360 tons. They are built entirely of steel, and care has been taken to make the hull as light as possible, and at the same time strong enough for the navigation of the high seas. They develop about 1800 horse-power of engines, attaining a speed of nearly 18 knots. They have three masts, and are provided with the latest improvements for handling torpedoes, and with apparatus for electric lighting, etc. Hotchkiss single-shot and revolving cannon form the gun battery. The tubes for the Whitehead torpedo are above water on each bow parallel with the keel.

The British Admiralty have prepared designs for this new class of vessels called "torpedo gunboat," and in October last issued proposals for their construction to leading shipbuilders in England. These vessels measure about 200 feet in length, while their displace-

ment with a mean draught of about eight feet will be 450 tons. They are to be built throughout of steel, the decks covered with wood planking. They will have four torpedo-launching tubes, one forward, one aft, and one on each broadside. Their gun armament will include a breech-loading 4-inch gun, and four three-pounder (47 millimeter) rapid-firing guns in addition to the machine-gun armament which it is now usual to supply to torpedo boats. They will be provided with twin screw engines of a total horse-power of about 2700, and the speed expected is from 18½ to 19½ knots. They will have a protective deck of about three-quarters of an inch in thickness, with a protection of coal of about three feet thick around the boilers and machinery.

We see from this what are the constituents of a modern fleet. The armored ships form the line of battle-ships; these are attended by tenders and dispatch boats and by the torpedo boats, which they launch before going into action, and to these are added the torpedo boat catchers whose province it is to destroy the torpedo boats of the enemy with their guns, as well as to operate as occasion may serve with torpedoes against their battle-ships. All of this formidable array of boats and small vessels is now considered necessary for the protection of the battle-ships against the spar and Whitehead torpedoes.

Admiral Hobart, Pacha, who commanded the Turkish fleet during the Turco-Russian war, gives his experience on this subject, and he considers that the power of the torpedo as a weapon of offence as well as of defence is enormously exaggerated. He does not deny the deadly effect of the weapon itself, but he rates the difficulties of successfully applying it very high, and with vessels at anchor he shows most effectively how the attack can be guarded against even with improvised means at the disposal of any well-equipped vessel of war. He anchored his ships in groups of four. These were surrounded by the boats of the vessels, twenty-four in number, which were anchored in a circle and connected together by a wire rope which is buoyed half-way between the boats. The boats are estimated at nine yards in length, the twenty-four spaces between the boats are fifty-four yards each, the radius of the circle described by the boats is five hundred and fifty yards, which keeps them four hundred yards from the ships. The wire rope is supposed to be immersed two feet in the water.

The object of the rope is to catch the screw of any attacking torpedo boat. The Admiral states that "it has been proved that common rope, used for want of anything better, has effectually

checked the career and capsized an attacking torpedo boat in her attempt to destroy a Turkish ship in the Black Sea during the last war; and I know that most satisfactory experiments with the wire rope have been made elsewhere. The result of these experiments was that a torpedo boat, steaming nineteen miles an hour, has capsized while dashing full speed on to an imaginary enemy's ship." An instance is also cited in actual practice where a most gallant and dashing attack made with a spar torpedo was frustrated by this system of guard.

In Admiral Hobart's article he incidentally contributes most important testimony to the ease with which the Whitehead torpedo can be made to deviate laterally from its course. He says: "One of these torpedoes struck the chain of the flag-ship and went on shore unexploded; another struck on the armored belt of a corvette and exploded, but, the blow *being at an angle*, it did no material injury." If we apply this evidence to the comparative directive power of the Whitehead and the Howell torpedo before referred to, we will see that in the two cases cited, where for want of directive power the Whitehead torpedo failed to accomplish any result, the Howell torpedo, possessing this property to an eminent degree, would have resisted the effort to deflect it, and would have achieved its object. This strikes me as very conclusive that it is a necessary requisite for an automatic movable torpedo to have inherent in it a positive directive force, so as to resist efforts calculated to cause deviation. The want of this is a defect which we find in the Whitehead, but we have it in the Howell torpedo as its most essential characteristic. I take much interest in the experiments with the Howell torpedo, and I hope the Government will carry them on on a liberal scale. I have faith in its success.

What has been stated is sufficient to show that there are two sides to the torpedo question, or rather, that the power of attack with the weapon is so much neutralized by means available for defence as to deprive it of the prestige it had acquired before means of defence were inaugurated. In shallow waters or in harbors where stationary mines can be planted or floated at convenient depth of water, they are a sure means of destruction, but with net protection, cordons of boats, secondary batteries and a bright lookout the evidence goes to show that to the present time the effect in offence has been very trifling in result. The great expense, however, of the present battle-ships makes it necessary to guard against all chances of service, and thus

we see that the nations having the most at stake in this matter consider it necessary to protect their fleets with supplementary squadrons of torpedo boats and again with torpedo-boat catchers. Thus far the matter rests much in the realm of theory; it remains for the realities of war to solve many of the questions which are now matters of opinion and discussion.

It will be noticed that in stating the constituents of a modern fleet, no mention is made of the ram. This class of vessel, built with sole purpose of operating the ram unsupported by other weapons, was considered some years ago as a suitable vessel to accompany the battle-ships and to take advantage of the melée to ram the enemy, but advancement in the development of this idea has ceased since the adoption of the torpedo boat. At present we find in the English Navy vessels either turret rams, as the Conqueror and Hero, carrying heavy guns in a single turret, or torpedo rams, as the Polyphemus, with complete facilities for ejecting the torpedoes, and armed with rapid-firing cannon and machine guns for defensive purposes, but no vessel intended to operate solely with the ram. It seems to be conceded that all the useful purposes of a ram can be performed by the fighting vessels themselves, all of which have a powerful permanent ram bow stoutly supported by the horizontal armor deck or armor belt. The first Advisory Board recommended that rams should form a part of our fleet, and the present Advisory Board has submitted the general features for one, but it was found necessary to give the vessel a displacement of 3000 tons so as to ensure a draught of water sufficient to enable the ram to operate below the armor belt of an armored vessel.

In referring to the armaments of the numerous classes of vessels which now form a modern fleet, we find that there are none that do not have a number of machine-revolving and rapid-firing single shot guns as a portion of the battery. So general is this application, that every ship carrying large guns now has two batteries, and in speaking of them they are indicated as the primary and secondary batteries. No modern cruiser or armored vessel would be complete without this secondary battery. They are considered necessary in general action for clearing open decks, for entrance through port-holes and, as their penetration is very satisfactory at long distances, for the damage they can do after perforating the sides of unarmored vessels; they are also handy guns for use in tops, and are indispensable for protection against boat attacks by boarding and by torpedoes. This aid to the primary

battery is regarded as an established provision for a modern battle-ship.

Accepting the correctness of this conclusion as applied to ships armed with modern artillery, how much more does it apply to ships armed with guns which are not fitted to answer the demands of modern warfare?

I was particularly impressed with this conviction during a late visit, on inspection duty, to the U. S. S. Brooklyn, just fitted for sea. I found the old historic ship in good order, well officered and with a young and hearty crew. Although she had been but five days from the navy-yard her organization was complete, and drills were already commenced; but as I stood on her poop-deck and looked down on a fine body of men at their quarters standing by their IX.-inch smooth-bore guns, my mind instinctively jumped to the contemplation of action, and I pictured to myself the scene if engaged with an enemy armed with modern artillery, and with speed that would prevent the Brooklyn from coming to close quarters, the only position in which her battery could be effective. I could recognize no hope in such a contest. The Brooklyn has besides her smooth-bore IX.-inch guns, one VIII.-inch converted rifle, one 60-pounder rifle, and four 37-millimetre Hotchkiss revolving cannon. The first two guns would be moderately effective at long range, but the 37-millimetre guns are only of use to guard the sides of the ship against torpedo boat attack. I felt that here, if anywhere, and more than anywhere else, was a need for the largest rapid-firing single-shot guns. The 57-millimetre Hotchkiss gun throwing a shell of six pounds weight, with a sufficient bursting charge, could be used to great advantage; its penetration at 1000 yards is sufficient to penetrate two inches of iron, and it would, without doubt, perforate the side of any unarmored vessel, and it would give encouragement to the men to feel that there were some means in their power by which they could give back the blows they were receiving.

While we remain in our present helpless condition in respect to our primary batteries, I think that a great effort should be made to increase the power of our secondary batteries; our ships should be supplied with as many of the 57-millimetre Hotchkiss single-shot guns as can be accommodated, and the 47-millimetre guns should be put in the tops. This gun can also be utilized as a boat gun for cutters that are now provided with no boat armament. The 37-millimetre revolving Hotchkiss cannon is undoubtedly the gun most efficient for

repelling boat and torpedo attacks, and the Gatling gun is indispensable for use on shore with landing parties, but for the secondary batteries of ships for purposes of general action, and for the protection and encouragement of men stationed at our smooth-bore guns, we should place in position as many of the largest sized single-shot rapid-firing Hotchkiss guns as can be accommodated.

This involves, I well know, the question of stowage, for the amount of ammunition for these guns must be liberal. Imaginary established rights to space and store-rooms will have to yield to the necessity of the chief want, and much that is now considered necessary in other departments may be found to be superfluous. Fortunately in our old-fashioned ships the aggregate of the space for stowage is ample, and a judicious curtailing of space occupied by other departments will, without doubt, result in accommodating the ammunition required to make the secondary battery effective.

STEAM ENGINEERING.

Equally important with ships and guns are all matters pertaining to steam engineering. Fortunately our coast trade and the navigation of our inland waters has saved us from being unable to build engines and boilers, and in this respect we may feel that we are equipped to such a point as will make only supplementary such improvements as may be found necessary when the reconstruction of the Navy shall assume an earnest character. On this subject, however, I shall allude, with deference, to two matters which I consider well worthy the thought and attention of those charged with the important duty of designing and building our engines and boilers. One is the weight of our engines, the other is the necessity of a new type of steam generators.

In determining the general features of a vessel of war, of a given displacement, the first question is as to the weight of the boilers and engines. If a certain speed is required, and the engineer declares that a certain weight of engines and boilers is necessary to produce it, it must be yielded to him as he is responsible for the horse-power to be developed. The constructor, ordnance and equipment officers must do the best they can with what is left of the displacement. I do not think that sufficient attention has been paid to reducing the weights of our engines. I am the more confirmed in this opinion by the comparison of the weights of engines in ships lately built abroad with those assigned to our vessels of similar displacement.

I am aware that it has been the habit of some engineer officers to read these statements with reserve, to accept them with certain grains of allowance: as, for example, it is said that many things which are entered in the sum of weights with us are not so entered abroad, such as fire-room floors, platforms, ladders, spare parts, etc., all the appurtenances. It is said that the published weights comprise nothing but the actual engines and boilers themselves. I have never investigated the basis on which these reports are made, consequently am in no position to allow or to disprove this assertion, but my mind has never been satisfied that the reason was satisfactory. It seems to me more natural to take the reports as expressing what they purport to do. I believe that by careful study of this detail we can reduce weights; no one will deny that we can reduce weights very much by substituting steel for iron in many parts of our engines, as the superior strength of the steel will allow of very much reduced dimensions.

But how much more can these weights be reduced if a multitubulous boiler be adopted as the steam generator! We are now brought face to face with a positive demand for great speeds; ordinary speed will not satisfy the demands of the times.

This can only be produced by increased power developed at the screw, which means an increased supply of steam to the engines. With the Scotch boiler this means a multiplication of the number of boilers in order to obtain the increased grate surface, and a consequent large increase in the weight of the boilers and water to be carried.

At present, in order to avoid the necessity of carrying so much weight, only made necessary at the highest speeds, abnormal means, as forced draught, have to be resorted to. The fire room is closed, the blowers worked with great violence, and the furnace, combustion chamber, uptake, and smoke-pipe are converted into parts of a blast furnace, the effect of which is to burn up and destroy rapidly all parts that are not surrounded by water. It seems to me that when we have reached the point where it is necessary to destroy the boiler in order to obtain the power demanded, it is time to look for a new steam generator. I am presenting no new idea, but I wish to emphasize the necessity of this effort, and to suggest to this Institute and to the Navy the necessity of action in this matter.

The two more familiar types of multitubulous boilers for sea-going vessels are the Herreshoff and the Belleville boilers. I hazard no description of them; they are familiar to you. They have been going

through a state of probation for several years. Mr. Herreshoff has increased the size of his boats which carry this boiler until he has a vessel of 94 feet in length, 11 feet beam, 28 tons displacement, 4½ feet draught aft and 3 feet forward, with which he has obtained a speed of 21 knots per hour. The French government has experimented with the Belleville boiler, and the performance of the dispatch boat Voltigeur, recounted in a paper published by this Institute in 1883, is well worth attention, for it conveys undeniable testimony of the success of the experiment; and in fact, the trial in May last of the French dispatch boat Milan, of 1560 tons displacement, 303 feet in length, and 33 feet beam, takes the matter out of the region of experiment, and exhibits the Belleville boiler as an accomplished success. This vessel, on a draught of water of 12 feet, has attained a speed of 18.4 knots, with a developed horse-power of 4000.

The Herreshoff and the Belleville are the only tubulous boilers that I know of that have as yet been applied to sea purposes, but we have the Babcock and Wilcox, and the Moore boilers of the same general character and type which are in use for stationary purposes, for heating or for working stationary engines, and no doubt these can be successfully applied to sea purposes by introducing modifications that would be found necessary in the new sphere of usefulness.

I will not attempt to institute comparisons, nor to discuss the details nor proportions of various types of boilers, but wish to emphasize the importance of a careful examination of a subject which promises to produce a safe and desirable marine boiler with a reduction of weight of 30 to 50 per cent. over the Scotch type, thus adding enormously to the total efficiency of a ship.

The designing of a small gunboat is now under consideration at the Navy Department. Her displacement is fixed at 800 tons. If the same conditions obtain as in the cases of proportional weight cited above, nearly one-sixth of this will be devoted to providing for the weights of her boilers and engines, and a tenth to the accommodation of coal, thus appropriating about one-fourth of the entire displacement. This is probably the best that can be done with the present type of boiler. The ever-increasing demand for storage for ordnance supplies, consequent upon the large charges of powder now used, and the space needed for the stowage of ammunition for the secondary batteries, has reduced the equipment outfit to a minimum, has contracted the dimensions of the hold so that provisions can only be

carried for a limited period, and seriously curtails the living spaces for the crew. A lightening of weights must be brought about in every department, and special effort should be made in those appertaining to the engines and boilers. If the law authorizing the new vessels did not preclude anything in the nature of an experiment, I don't hesitate to say that I would like to see the first experiment in this direction made on this new gunboat; if the result were to be a total failure, I should consider it cheap experience. And it is well to mention just here another advantage attending these multitubulous boilers—that there is no trouble in removing them, as they are arranged in sections which can be renewed without tearing the ship to pieces by taking up decks. This concludes what I have to say on this subject. It may be that I underestimate some of the difficulties which I know exist in making this new departure, but in consideration of the advantages that will ensue from a successful application of this steam generator, I think they are worth the effort.

HYDROGRAPHIC OFFICE.

After touching on subjects on which our Navy is deficient, it is a relief to turn to one branch of the service where our advance is not only creditable but promises to equal, if not to surpass, the development of similar work in foreign governments. I allude to the Hydrographic Office.

A large number of officers are connected with this office, but the work is of such a character that it does not force itself so much on the attention of the service as do other branches. Its primary work is to supply our ships with charts and to carry on original surveys out of the waters of the United States; but the duties to effect this are multifarious, and a very perfect organization is necessary in order to guard against errors or oversights which might produce very serious results. This office must be sure that, in distributing charts and sailing directions, it has the latest and most trustworthy information; accuracy is indispensable in the charts by which a ship is navigated. It is customary to place implicit confidence in a chart, unless warned of inaccuracies, and the responsibility of accident falls on the Hydrographic Office if reasonable precautions have been taken by the ship. It is, thus, very important to be able to trace error to its source, and in the organization of this office every precaution is taken to ensure this personal responsibility. It is impossible to assert that no error can occur in any system, how-

ever perfect it may seem to be, and however faithfully the agents may work; but where a system is so arranged that an error is sure to be traced back to the person responsible, there is no doubt that a special guard against inaccuracies has been secured. The checks that are introduced in this respect in the Hydrographic Office secure this personal responsibility and it must inspire much confidence in the work of the office.

The office is in correspondence with all similar institutions in the world, also with our ships of war and the United States consuls in the seaboard countries, and no chart is issued until all known charts of the region have been consulted and all information has been collected from every available source.

At present the larger portion of charts issued to the Navy are purchased abroad, the British Admiralty charts being in the largest proportion. In fact the Navy is practically dependent now on Admiralty charts, which form 85 per cent. of the chart outfit of a cruiser on the European station, 76 per cent. on the Asiatic, 30 per cent. on the Pacific, 40 per cent. on the South Atlantic, and even 25 per cent. on the North Atlantic station. Corrections are being constantly made and new charts purchased, but the ultimate object of the Hydrographic Office must be to make itself independent of foreign purchases, and to equip itself with its own original plates of all the waters of the world. We have only to imagine a state of war to recognize at once the necessity of thus providing ourselves. Of course the plates must be electrotyped for printing purposes, all of which requires time and money. This necessity is recognized by the present accomplished and energetic hydrographer of the Navy, and small sums each year are devoted to this purpose as they can be spared from current expenses, but the work should be separately provided for as a distinct object, and appropriations made accordingly. It must be remembered that this need exists not only for the Navy, but for the merchant marine, which is forced to purchase its foreign charts of dealers, who naturally sell to them charts of old date as long as any of the old stock is on hand.

The number of original plates now in the possession of the Hydrographic Office is about 350, and quite a number of them are electrotyped, but when we consider that the number of charts required for navigating all the waters of the world now reaches over 3000, we see that there is much labor yet in store for the office before we can be considered independent in this matter. All other nations of any

importance are entirely independent in this respect, and the thorough organization that now obtains in our office justifies this consideration for it.

All other details appertaining to such an institution are carefully worked out. Sailing directions always corrected to date and notices to mariners are issued with dispatch, and our consuls abroad are kept informed of all that transpires necessary to be communicated to our merchantmen abroad.

One of the best proofs of the practical value of the Hydrographic Office is the favor with which it is regarded by our merchants and merchant captains. The establishment in our principal seaports of branch offices has had much to do in calling its usefulness into notice. It is found now that ship captains bring their charts to these offices for verification and correction, and many are surprised to find that new editions of their charts showing quite different hydrographic conditions have long since supplanted those which they were using. The notices to mariners, also, which give immediate notice of newly discovered dangers, are thus more rapidly communicated to those who are the most interested in them. The interests of ship captains, thus aroused, works now to the advantage of the office itself, for it is in constant receipt of information communicated by those who have been benefited by its operations. The sale of the hydrographic charts has also increased to a great extent.

A striking feature in the work of this office is the monthly issue of the pilot chart of the North Atlantic Ocean, which presents graphically any information relating to the North Atlantic of interest and value to mariners. There appears on the chart a statement of the information collected during the month preceding and a forecast of what may be expected during the month following. This chart is carried by all Trans-Atlantic steamers, and many of them are sailed in accordance with its instructions. The prevailing winds, the position of icebergs and that of wrecks along this highway of the ocean are items of knowledge much needed by the navigator, and it is expected that the observations now being collected will enable the office, in a short time, to lay down a very close approximate limit of fogs during the different seasons of the year which will be a valuable addition to the present guards against accidents.

We can congratulate ourselves on the creditable and most useful work that is being done by this branch of the Navy Department, and it is to be hoped that our present able hydrographer may be encour-

aged in his work by liberal appropriations to enable him to make the Government independent of foreign aid in the supply of charts.

I have finished the work that I set myself to perform. With the exception of the Hydrographic Office, which I recognize as established on a sound basis and only needing appropriations of money to make it independent of foreign aid, the subjects on which I have touched are those in which we are most deficient. I have confined myself to them as being the essential ones to be borne in mind as needing attention in the work of rehabilitation. The main object of my address is to preach encouragement to those who are left to occupy the field of action. The chance for speedy restoration to the position that the Navy once occupied is not cheering at present, but we have cause for encouragement in the fact that the first steps have been taken, and it is the first step that always costs the most effort. We have the right to recognize that the advance has commenced, and it is the duty of every individual member of the service to prepare to do his share in aiding the movement.

As I said before, notwithstanding the decadence of the *materiel* of the Navy, we have reason to be proud of the condition of its personnel, and we feel confident that it embodies talent capable of treating the many questions of science and practice that are to be encountered. These involve much work and demand thorough knowledge of the subjects to be treated, and I am tempted to emphasize the source from which the Navy, at this time of trial and exacting requirement, draws the strength which enables it to respond to the call made upon it. The source of power is in the Naval Academy which has saved the Navy. The portion of knowledge there acquired has expanded the minds of its graduates, and their habits of study have enabled them to go on and better their instruction. The result has been the wide dissemination in the service of advanced ideas which keep pace with progress and fit the officers for the work they are called upon to perform.

I have the honor of being the senior graduate from the Naval School at Annapolis, but I did not enjoy the advantage of the academic course, which came after my time. I claim it, however, as my Alma Mater, and I take as much pride in it as do those of younger classes; and, in concluding my remarks, I would say to all graduates that, while we cling with affectionate memory to the associations that surround the Academy, and while we love to share

with it the credit that its graduates have achieved, we should not forget him to whom we owe the gift, we should ever keep green the memory of its founder. It was the Honorable George Bancroft, who when charged, in 1845, with the care of the naval branch of the service, looked ahead into the future, and foreseeing the march of progress, and well appreciating the needs of *education*, conferred upon the Navy that ineffable boon, the full advantage of which we now reap. This revered sage still goes out and in among us, loaded with years and honors that a grateful people has bestowed, and occupying his time in still further adding to his enviable reputation in the present and rearing a literary monument which will preserve his memory to posterity; but no class of his countrymen have so much cause to respect and honor him, or have so strong a reason for gratitude to him as have the officers of the Navy.

The Chairman proposed the thanks of the meeting to Rear-Admiral Simpson for the valuable and interesting paper, and they were unanimously given. The meeting then adjourned.